

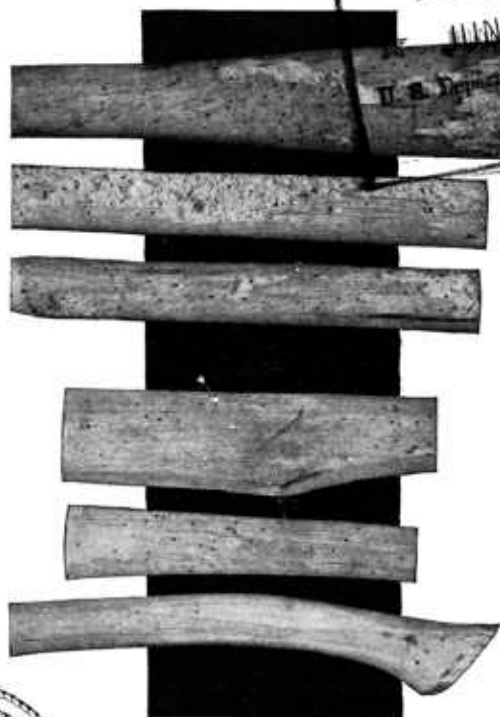
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Feb. 1938

PREVENTING DAMAGE
BY LYCTUS POWDER-POST
BEETLES



POWDER-POST damage to lumber, the woodwork of buildings, furniture, implement handles, etc., constitutes a serious annual loss throughout the United States to our rapidly diminishing supply of available hardwoods. As this bulletin shows, such losses can be prevented by periodical inspection of lumber and other hardwood stock, proper classification, rapid utilization, and the application of certain preservative treatments. Kiln drying and the use of insecticides are effective remedies.

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PREVENTING DAMAGE BY LYCTUS POWDER-POST BEETLES

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INJURY AND HABITS

LYCTUS powder-post beetles (fig. 1) cause extensive losses in the seasoned sapwood of hardwood lumber, implement handles, furniture, etc., especially ash, hickory, and oak. Damage of this type is distributed widely throughout the world, for many species of these beetles are carried from one country to another in the commercial products which they infest. No species of hickory is immune to attack, nor is ash from the Northern States more resistant to attack by *Lyctus* beetles than ash grown in the South.

The winged adult beetles are small, slender, somewhat flattened, reddish brown to nearly black, and about three-sixteenths inch in length. They lay their eggs (fig. 2) in the pores of the wood, and the larvae or grubs (fig. 3) which hatch from them burrow through the wood and reduce the fiber to a flourlike powder (figs. 4 to 9). The different kinds of *Lyctus* beetles vary somewhat in their habits and seasonal history, but there is a general similarity. They pass the winter as larvae in the wood, change to pupae (the resting stage) in early spring, and in late spring and early summer the adult beetles emerge from the wood and fly about. Under natural out-of-doors conditions the eggs are laid in the pores of the wood soon after activity commences in the spring; but in storehouses, sheds, or buildings kept warm and dry the development may take place and the eggs may be deposited much earlier.



FIGURE 1.—Winged adult of a powder-post beetle, *Lyctus planicollis*. Greatly enlarged.

EVIDENCE OF ATTACK AND CHARACTER OF POWDER-POST INJURY

Infested wood may be detected by the fine, flourlike powder found on or beneath piled or stored hickory, ash, oak, and other seasoned hardwood products. During the first year of infestation the powder comes from exceedingly minute holes in the wood, but after the second year the small holes from which the beetles have emerged are more or less conspicuous, and from these the powder will fall when the infested material is moved or jarred. When the wood is cut or split the interior is often found to have been converted into a mass of closely packed powdery material which has been held together by an outer thin shell and intervening fibers of sound wood. The grubs, burrowing through the solid wood in all directions, have pulverized the wood fiber and have packed their burrows with this powdered wood. The injury done by *Lyctus* beetles is always confined to the white wood or sapwood, although the heartwood is sometimes penetrated when the matured beetles are emerging from the wood.

CLASSES OF FOREST PRODUCTS DAMAGED

A great variety of seasoned hardwood products is subject to powder-post damage, especially hickory, ash, and oak woodwork of farming machinery and implement handles; ladder stock such as rungs, etc.; and vehicle stock such as hubs, spokes, felloes, rims, singletrees, poles, and shafts. Other products affected include the woodwork of electric streetcars; shipbuilding lumber; such Army and Navy stores as handles, tent poles, wheelbarrows, oars, and many other hardwood articles; interior finish or trim and ornamental woodwork, as panels, mantels, doors, doorposts, staircases, wainscoting, flooring, etc.; construction timber, including beams, joists, roof framing, etc.; furniture, including tables, chairs, bureaus, cabinets, refrigerators (before use), filing cases, piano stock, bookcases, cabinet-work, etc.; inside rustic work; wood specimens and curios in museums; cooperage stock (barrel-stave bolts); shoe-last blocks; walking sticks, umbrella handles, measuring rules, and blocks to be converted into golf-stick heads; fish-net hoops; ornamental bamboo; Japanese fans; shuttle blocks, and "picker" sticks (for driving shuttles in looms), etc.

Hickory, ash, and oak are the kinds of wood most liable to injury, but persimmon, osage-orange, black walnut, butternut, maple, elm, wild cherry, locust, poplar, sycamore, eucalyptus, sassafras, orange, red gum, sweet birch, fig, bamboo, and other woods are also attacked.

PREVENTION OF ATTACK

INSPECTION, CLASSIFICATION, AND RAPID UTILIZATION

The adoption of the following system of periodical inspection, classification, and rapid utilization of the older seasoned sapwood of hardwood stock will prevent attack:

- (1) Inspect material in yards and storehouses at least annually, preferably in November and February, especially stock that is two or more years old, and remove for destruction or treatment (see pp. 3-6) all material, if any, showing evidences of powder-post attack.

- (2) Burn all useless sapwood material and prevent the accumulation of refuse material in which the insects can breed.

(3) Classify, as far as possible, all dry or seasoned hardwood stock (a) by species or kinds, as hickory, ash, oak; (b) by quality, as heartwood, pure sapwood, part sapwood; and (c) according to age; that

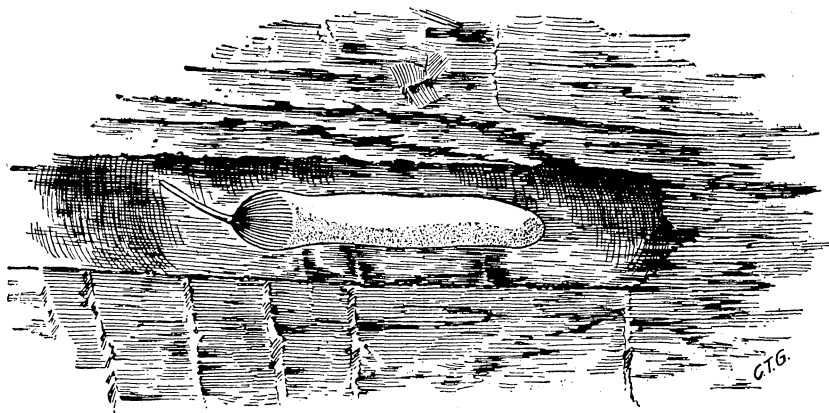


FIGURE 2.—Egg of a powder-post beetle, *Lyctus planicollis*, in pore of wood on radial section of ash ladder-rung stock; pore opened to show egg. Highly magnified.

is, the number of years it has been seasoned. If the stock is thus classified only the sapwood piles need be handled and repiled in case of infestation—a saving of labor, time, and worry. The heartwood is not attacked and need not be inspected, and the piles of the older stock can be used first (fig. 10).

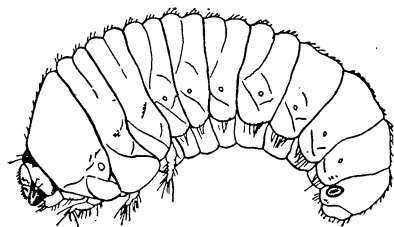


FIGURE 3.—Larva of a powder-post beetle, *Lyctus cavicollis*. Enlarged. (Craighead and Böving.)

(4) Utilize or sell first the oldest stock on hand. Prevent the accumulation of old stock; in other words, keep the stock moving.

(5) Where possible, utilize heartwood material, which is just as strong¹ and as suitable as the sapwood and is not attacked by *Lyctus* powder-post beetles (figs. 8 and 9).

Manufacturers are overcoming the purely arbitrary trade prejudice for "whitewood" implement handles by painting all stock red. As a result, heartwood and sapwood are used indiscriminately, and the paint protects the sapwood stock from subsequent attack by *Lyctus* beetles. Use only heartwood piling sticks in lumber piles.

(6) Inspect all new stock to prevent the introduction into lumberyards and storehouses of powder-posted material, and place any doubtful material in quarantine for several months' observation.

PROTECTIVE APPLICATIONS AND TREATMENTS

Linseed oil or coal-tar creosote.—If the beetles have not been eliminated from the yard and storehouses, stock that has been air seasoned longer than eight months, or has been kiln-dried for a

¹ Exhaustive strength tests conducted by the Forest Service show that the heaviest, and consequently the strongest hickory averages below 10 rings per inch in rate of growth, and that, weight for weight, red hickory (heartwood) is as strong as white hickory (sapwood).

shorter period, and which is to be held in storage, may be rendered immune by treatment with two coats of boiled linseed oil applied hot, or it may be immersed in vats of hot oil. The boiled oil will dry more rapidly than the raw linseed oil, especially if kerosene is added to the hot oil. The wood should be treated between October and March. Linseed oil has an advantage over other substances in that it can also be profitably applied to un-

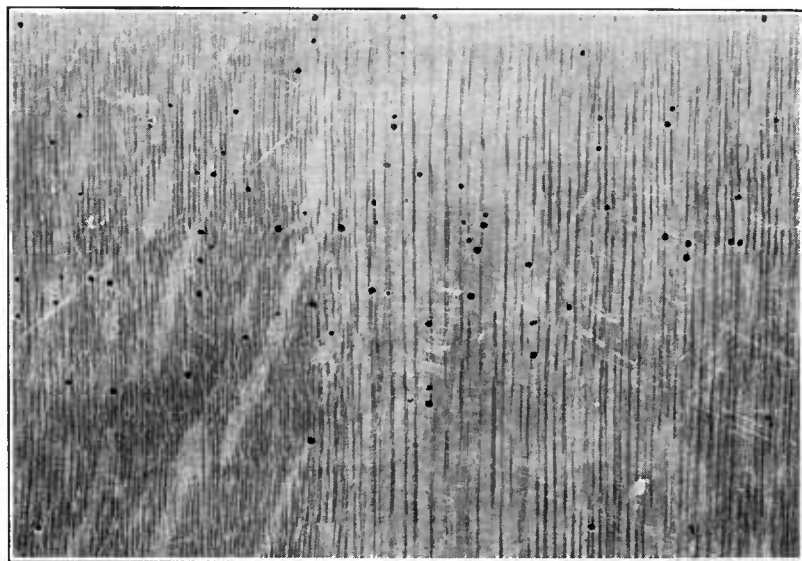


FIGURE 4.—Powder-post oak file case, showing exit holes of adult beetles; work of *Lyctus planicollis*.

seasoned timber, since it will prevent checking in seasoning. This oil stains the wood slightly yellow; in case of wagon stock, however, it can be used without prejudice to the trade and is an effective preventive. The standard coal-tar creosotes can be effectively used in case of stock to which the brown stain will not be undesirable or detrimental. The wood should be dipped in vats of hot creosote, or the preservative should be applied hot with a brush.

Fillers.—In the case of finished products or the more valuable material, any substance which closes the pores of the wood may be effectively applied. For example, paraffin wax, varnish, shellac, lead paints, or other fillers, such as a mixture of resin and lampblack (as used on the ends of walnut gunstock blanks), which will also prevent season checking, effectively close the pores of the wood and prevent the beetles from depositing the eggs, which are laid in these pores. Thus the sapwood portions of backs and interior surfaces of cabinet work, inside finish, furniture, etc., should be treated to prevent attack, and such procedure will prove economical.

Repellents.—It has been found that coal-tar creosote acts as a repellent to adult *Lyctus* powder-post beetles. Lumber, implement handles, wagon stock, etc., which cannot be given a direct treatment with the creosote on account of the stain it leaves, can be protected

by storage in sheds the woodwork of which has been treated with coal-tar creosote. Although it is advisable to construct new storage buildings of creosoted timbers, the interiors of buildings already constructed of untreated timbers can be sprayed with creosote. This spraying treatment will act as a repellent, but it cannot be abso-

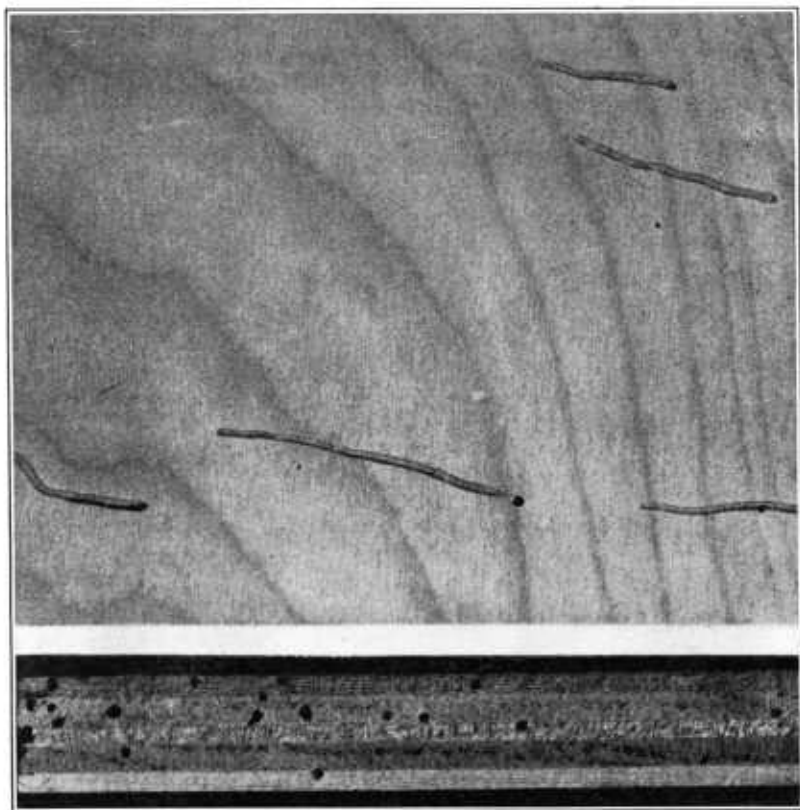


FIGURE 5.—*Lyctus* powder-post damage to veneered 3-ply boards.

lutely relied on if the products are to be stored for long periods. Valuable finished stock sprayed with orthodichlorobenzene will be protected from attack, especially if in a closed shed, until the volatile chemical disappears; then the treatment must be repeated.

Submergence in water.—Submergence of sapwood hardwood material in water for periods of 4 months or longer leaches out or changes the food values in the cells, rendering the wood unfavorable to *Lyctus* powder-post beetles, so that it is not liable to subsequent attack.

Steaming under pressure.—Thorough steaming of wood for various periods at different pressures apparently so changes the wood that it is no longer suitable for *Lyctus* powder-post beetles. Tests conducted with white-ash boards steamed for 10 and 20 hours, respectively, at 28 pounds pressure, and for 17 hours at 45 pounds pressure, show that such treatments are effective in preventing attack. The

wood is rendered darker in color by steaming, and in certain cases this might be disadvantageous.

REMEDIAL MEASURES

DISPOSAL OF INFESTED STOCK

After inspection of stock all infested material, including infested sap edges of lumber, etc., should be eliminated by sorting it out, trimming off or cutting away infested parts, and disposing of it by burning or otherwise. Such infested articles as may be tested for

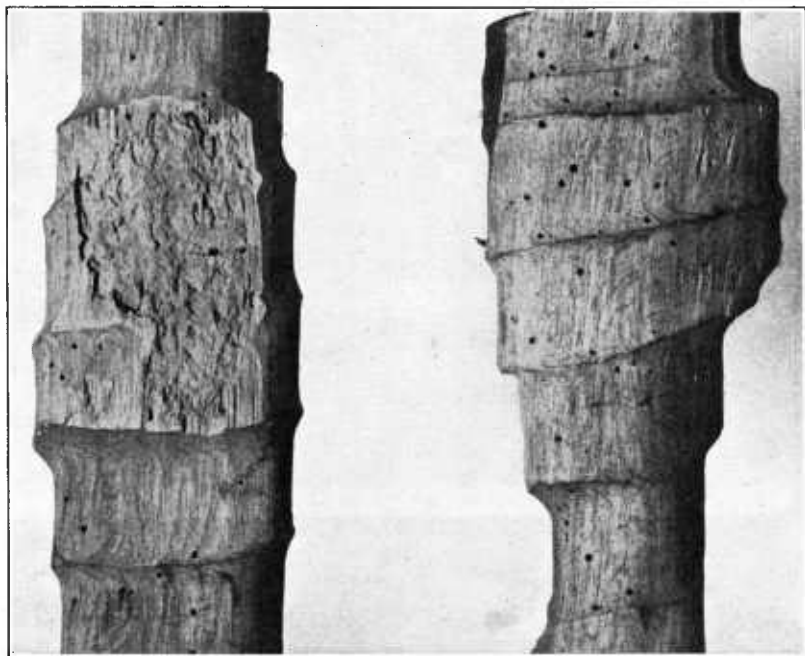


FIGURE 6.—Shoe-last blocks damaged by *Lyctus* powder-post beetles.

required strength and found to be of sufficient value after treatment may be retained. Stock only slightly infested should be treated with kerosene oil or orthodichlorobenzene (pp. 7-11), or should be kiln-dried (p. 12), after which it should be kept in quarantine a sufficient length of time to determine whether or not a second treatment is required.

Such control work should be done between October and March 1 where the wood is in closed storehouses, and before April 1 where in the open. If thoroughly done and if by annual inspection thereafter infested material is disposed of as soon as found, there will soon be no trouble from powder-post beetles, unless there is a continued introduction in lumber and material received from other yards and localities where methods of control are neglected. To avoid this all material should be carefully inspected before shipment, or at least held in quarantine for observation before it is placed in the yards or storehouses.

In the case of the more valuable stock, or where the removal of the infested parts is not practicable, the wood should be subjected, between October and March 1, to methods of treatment for the destruction of the insects. Of the following remedies the one most suitable should be selected in each case, it being remembered that the treatment must not be detrimental to the wood for subsequent uses.

KILLING THE INSECTS IN STOCK TO BE SAVED

Insecticides.—If there are large quantities of powder-posted stock these should be given liberal applications of pure kerosene oil or

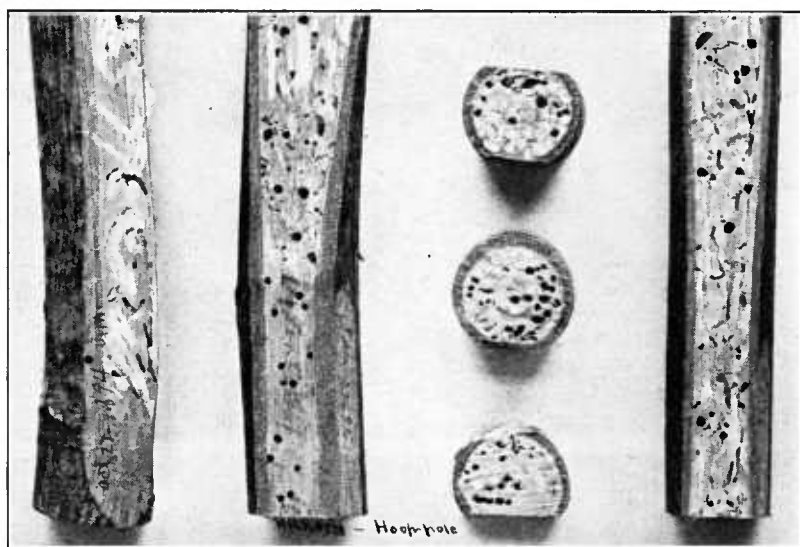


FIGURE 7.—Hoop poles powder-posted by *Lyctus* beetles. Such thin stock seasons rapidly and may be attacked before it has seasoned for eight months.

orthodichlorobenzene as a spray or with a saturated brush or mop, or the infested wood should be immersed in vats of kerosene. Several applications may be necessary. The only objection to kerosene is the fire risk. Kerosene soon evaporates, however, so that the treated material is not long near the danger point. Neither kerosene oil nor orthodichlorobenzene affects the subsequent application of shellac or varnish, although in the finishing process it is more difficult to stain kerosene-treated sapwood to match the rest.

Mixtures of 3 parts of coal-tar creosote and 1 part of kerosene oil,² of 3 parts of kerosene oil and 1 part of creosote (to obtain a deeper penetration), and of 1 part of creosote and 3 parts of naphtha have been used successfully in killing insects in infested stock. The wood should be dipped in vats of the mixture, preferably heated by coils of steam pipe, or the mixture may be applied hot with a brush. Of course, mixtures containing kerosene oil should not be heated over a direct fire.

² This mixture should be strained through burlap before it is used.

TREATING WOODWORK OF BUILDINGS AND FURNITURE

In the case of powder-post damage to the timbers, interior woodwork, or furniture in buildings, the infested wood should be drenched

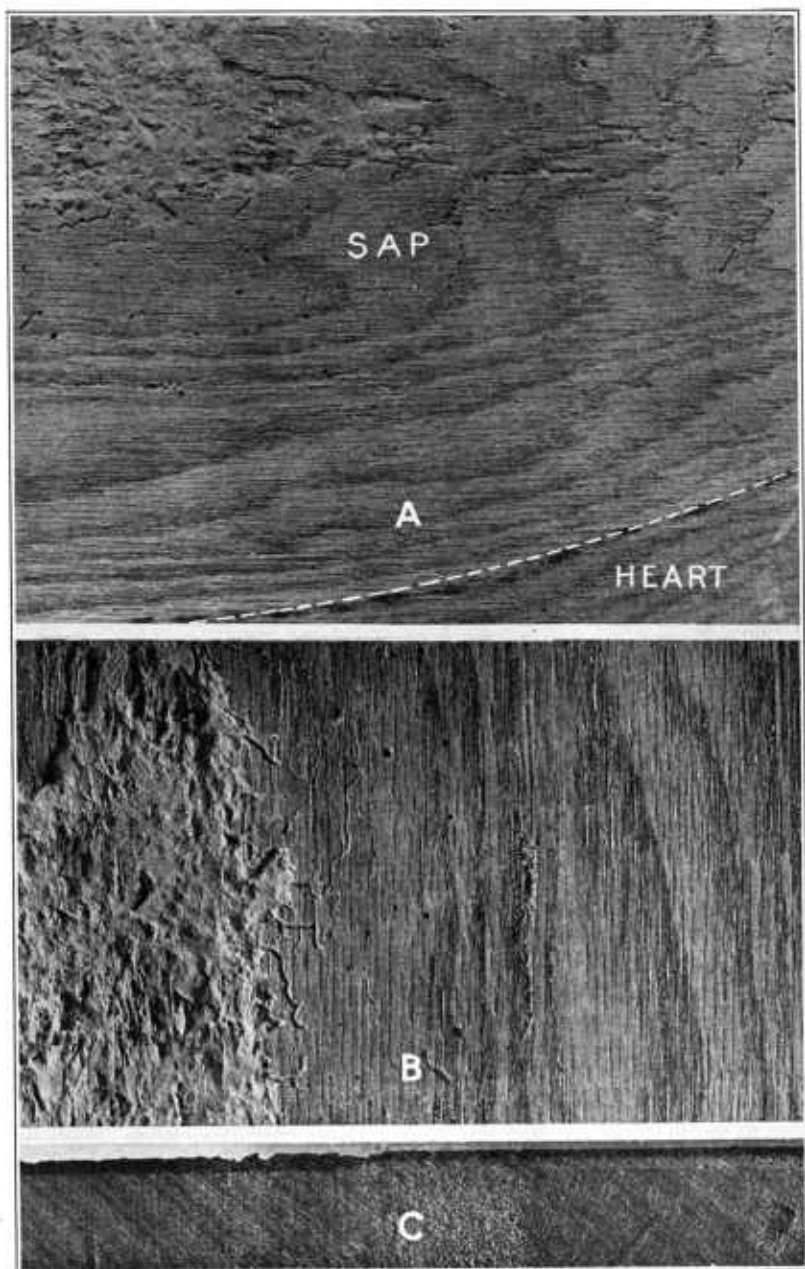


FIGURE 8.—A, Oak sapwood powder-posted by *Lyctus planicollis* (note that the heartwood oak is not attacked); B, oak, sapwood veneer (door stock) powder-posted by *Lyctus planicollis*; C, end view of same, showing uninfested chestnut core.

with orthodichlorobenzene with a brush, saturated rag, or mop, or if this is impracticable, the timbers should be sprayed with this liquid. Several applications may be necessary, and careful examination should be made after the treatment to determine whether it has been successful.

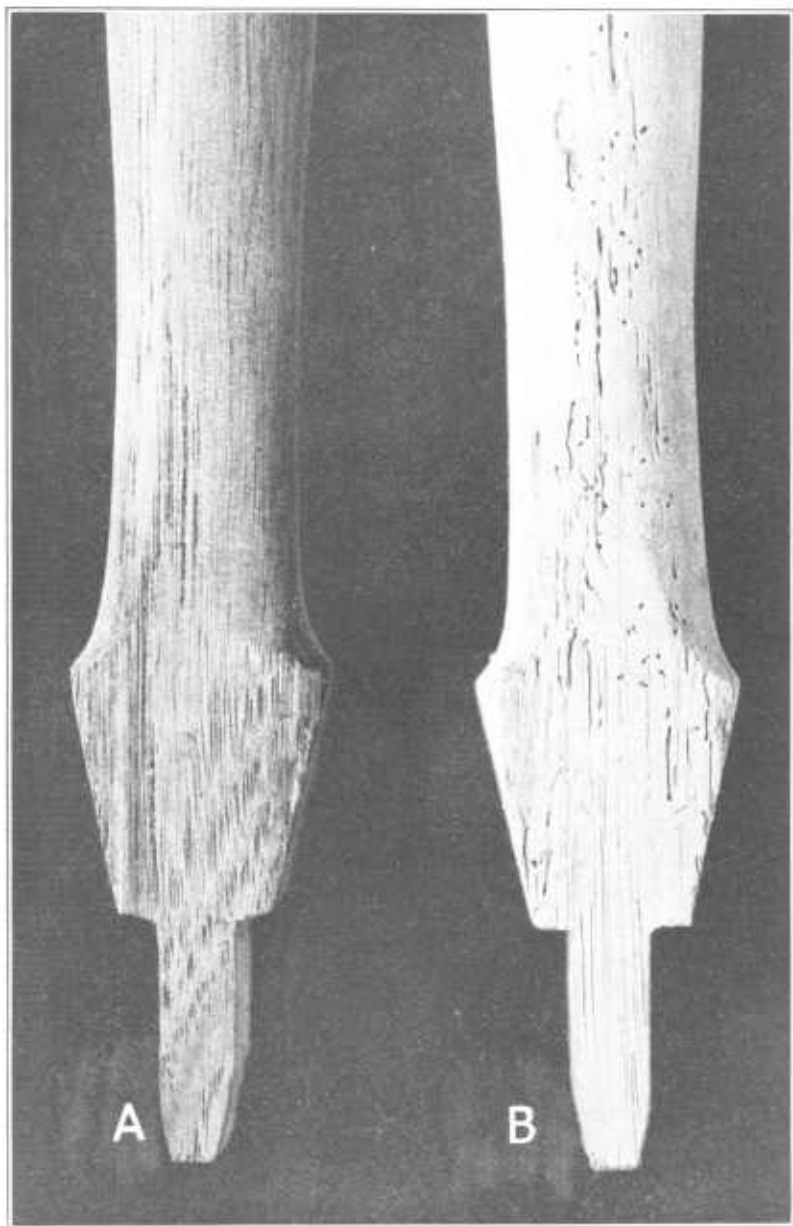


FIGURE 9.—Two finished hickory spokes: *A*, Red heartwood, undamaged; *B*, white wood, severely damaged; work of *Lyctus* powder-post beetles.

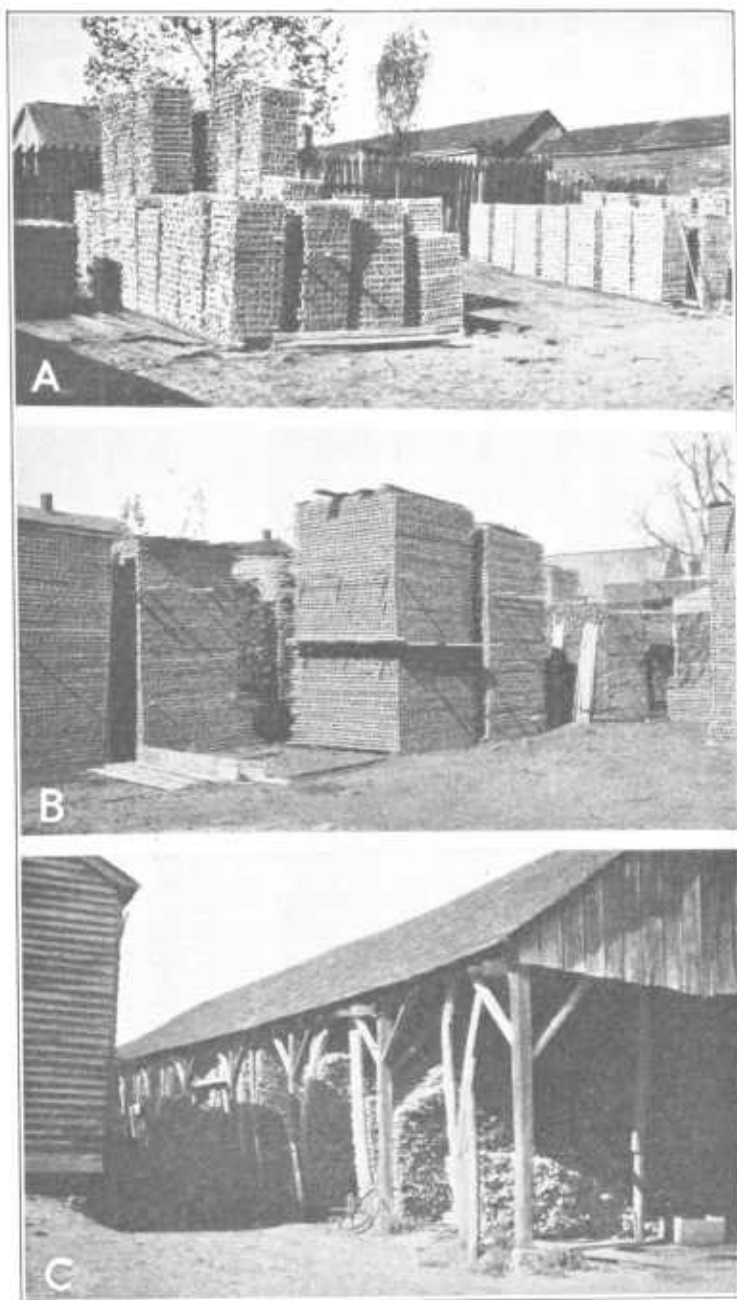


FIGURE 10.—*A* and *B*, Hickory billets piled in a yard in Kentucky. A great deal of labor and time is required to examine and repile large quantities of mixed stock where infestation exists; it is therefore desirable to pile heartwood and sapwood separately; *C*, infested sapwood hickory billets in a shed.

If the borers are too deep in the wood, or if the wood is structurally weakened or rendered unsightly, it should be replaced with heartwood or softwood materials which are not attacked by Lyctus beetles.

If orthodichlorobenzene is used as a spray, it is advisable to open up the house, since there is an odor to the chemical which may prove disagreeable in a closed room. Also, in spraying timbers overhead care should be taken not to let the liquid drip down, since it might slightly burn the face and hands and would be especially injurious if it got into the eyes.

The orthodichlorobenzene treatment is likely to remove the finish from the woodwork or furniture. After the treatment, if no further evidence of the insects appears, the wood can be refinished if necessary.

When orthodichlorobenzene and coal-tar creosote are used in buildings where food is dispensed or stored, the infested material should be removed, and the treatments should be made out-of-doors. The treated material should then be held for some time before being replaced in the building, so that all trace of disagreeable odor will have disappeared.

When wood is so badly eaten as to be unsightly or as to have lost its firmness, wiping it with melted paraffin will restore its firmness. The excess paraffin can be removed and the wood then refinished or varnished.

Steaming.—Treating infested dimension stock, at either atmospheric or higher pressures, in a kiln maintained at a temperature of 130° F. by introducing live steam is an effective remedy. Wood up to and including that 1 inch thick should be kept in the kiln for 1½ hours after all parts of the material have reached that temperature. Thicker material requires longer treatment. R. C. Fisher,³ in verifying the foregoing recommendations for the control of Lyctus beetles, determined the period of time necessary for infested ash or oak of various thicknesses to reach this temperature when placed in a kiln. For safety the wood should be left in the kiln somewhat longer, and then subjected to live steam for 1½ or 2 hours in a saturated atmosphere. Parkin⁴ extended Fisher's work to include relatively low temperatures and humidities. The time of treatment covering the work of both of these investigators is shown in table 1.

Steaming under high pressure, however, may weaken and discolor the wood and should not be applied to wood to be used for fine finish or where great structural strength is essential. The humidity should be at the saturation point.

Kiln drying.—Subjecting seasoned wood to a temperature of 180° F. in dry kilns is also an effective remedy. As Lyctus powder-post beetles are able to survive the commercial dry-kiln processes, it is necessary, in order to kill the larvae in infested wood, not only to run the infested material through the ordinary process but at the end of this operation to have the temperature raised to 180° F. or over for a short period—one-half hour or longer, depending on the

³ Lyctus powder-post beetles. Forest Products Reserves Bulletin 2, Department of Science and Industrial Research [England].

⁴ The Kiln-Sterilization of Timber Infested by Lyctus Powder-Post Beetles, by E. A. Parkin. Forestry (London), vol. 11, pp. 32-39. 1937.

dimensions of the material. Such high temperatures may weaken the wood fibers, and should be used only where great strength is not needed in the utilization of the wood.

According to the Forest Products Laboratory of the United States Forest Service, under ordinary circumstances the mechanical properties of the wood will not be appreciably impaired by a temperature of 180° F. maintained for an hour. It will be necessary to keep the humidity up to a point at which no surface drying will take place. Such severe treatments have been used upon 5- by 7-inch wagon bolsters without deleterious effect upon their strength, and the Forest Products Laboratory frequently recommends, in the interests of good drying, that the stock be given a preliminary steaming or high-humidity treatment at temperatures considerably in excess of the initial drying temperatures. *Kiln-drying the sapwood of hardwoods will not prevent subsequent attack by Lyctus beetles.*

Fumigation.—Fumigation of infested wood in tightly closed drying rooms with the fumes of sulphur at the time of the emergence and flight of the adult beetles is recommended *only* for killing the adult beetles and preventing egg laying.

TABLE 1.—Schedule for treating wood to prevent damage by powder-post beetles

Relative humidity (percent)	Lethal temper- ature required	Thickness of timber	Time re- quired to overcome lag after kiln has attained lethal tem- perature	Additional margin of safety	Time then held at lethal tem- perature	Total period of exposure after kiln has attained required conditions
	°F.	Inches	Hours	Hours	Hours	Hours
100-----	130	1	1½	1½	1½	2½
		2	2	1½	1½	4
		2½	3¼	1½	1½	5¼
		3	4½	1½	1½	6½
	125	1	1½	1½	2	3
		2	2	1½	2	4½
		2½	3¼	1½	2	5¾
		3	4½	1½	2	7
	120	1	1½	1½	6	8
		2	2	1½	6	9½
		2½	3¼	1½	6	10¾
		3	4½	1½	6	12
	115	1	1½	7½	30	38
		2	2	7½	30	39½
		2½	3¼	7½	30	40¾
		3	4½	7½	30	42½
	125	1	1½	1	4	5½
		2	2	1	4	7
		2½	3¼	1	4	8¼
		3	4½	1	4	9½
80-----	120	1	1½	2	7	9½
		2	2	2	7	11
		2½	3¼	2	7	12¼
		3	4½	2	7	13½
	115	1	1½	9	36	45½
		2	2	9	36	47
		2½	3¼	9	36	48¾
		3	4½	9	36	49½
	125	1	1½	9	36	45½
		2	2	9	36	47
		2½	3¼	9	36	48¾
		3	4½	9	36	49½
60-----	120	1	1½	9	36	45½
		2	2	9	36	47
		2½	3¼	9	36	48¾
		3	4½	9	36	49½
	115	1	1½	9	36	45½
		2	2	9	36	47
		2½	3¼	9	36	48¾
		3	4½	9	36	49½
	125	1	1½	9	36	45½
		2	2	9	36	47
		2½	3¼	9	36	48¾
		3	4½	9	36	49½

INSECT PARASITES, PREDATORY ENEMIES, AND SCAVENGERS OF
LYCTUS BEETLES

Although several species of parasitic⁵ and predatory⁶ insects attack Lyctus powder-post beetles, they cannot ordinarily be depended upon to keep these destructive beetles under control. Small wasplike parasites have been reared in large numbers year after year from wood in quantity infested by Lyctus powder-post beetles and confined in large breeding cages, yet the numbers of the beetles did not seem to be markedly reduced, even though no hyperparasites (parasites of the parasites), which if present would have interfered with the work of the beneficial parasites, were reared. Parasites and adult Lyctus beetles continued to emerge in numbers from the infested wood for from 4 to 10 years. It would seem that such conditions of confinement should render the parasites more effective than under natural conditions in the open. Both the Lyctus beetles and the parasites gradually decrease in size, after many years of such breeding.

Not to be confused with these beneficial parasitic and predatory insect enemies of Lyctus powder-post beetles, although often found with them, are certain insects which act as scavengers.⁷

SUMMARY

Powder-post beetles often ruin stored hardwoods of the finest quality by turning them into a flourlike powder. They work in whitewood or sapwood, especially second-growth hickory, ash, and oak, which has been stored or piled in one place for two or three years or longer. They are attacked by parasitic and predatory insects, but these cannot be depended upon to keep them in control.

Sapwood air seasoned for less than 8 or 10 months will not be attacked,⁸ and heartwood is never attacked and should be utilized wherever possible.

By the adoption of a system of inspection, classification, and proper disposal of the seasoned sapwood of hardwood stock, loss by powder-post beetles can be prevented.

Inspect material in yards and storehouses annually, preferably in November and February, and sort out and burn material showing evidence of powder post. Burn all refuse and useless sapwood material.

⁵ According to S. A. Rohwer, assistant chief of the Bureau of Entomology and Plant Quarantine, to whom the many species of wasplike parasites that have been reared were submitted for identification, a braconid, *Hecabolus lycti* Cress., is undoubtedly the predominating parasite of the common southern Lyctus beetle (*Lyctus planicollis* Lec.), and has been reared in enormous numbers from wood infested by this species. Several other species of braconid parasites of Lyctus beetles, however, have been reared in quantity.

⁶ A very effective predatory enemy of Lyctus beetles is the clerid beetle *Tarsostenus univittatus* Rossi, which had been reared from wood infested with the southern Lyctus beetle (*Lyctus planicollis* Lec.). The larvae of this clerid prey on the Lyctus larvae, and the adult clerid beetles rapidly pursue and devour the adults. The adults of this clerid resemble the adult Lyctus beetles, especially the large female spotted with powder from infested wood. There are also many other insect enemies, such as the histerid beetle *Teretriosoma americanum* Lec.

⁷ Among the scavengers are a wingless psocid (*Troctes divinatoria* Müll.), a dermestid beetle (*Trogoderma inclusum* Lec.), and among the cucujid beetles *Silvanus surinamensis* L. (the cadelle) and species of *Laemophloeus*.

⁸ Very thin stock, such as hoop strips (fig. 7) for barrels, etc., may be attacked before the end of this period because of more rapid seasoning. Kiln-dried stock is also subject to attack sooner than this.

Classify seasoned hardwood stock into hickory, ash, oak, etc.; heartwood, pure sapwood, and part sapwood; and according to the number of years seasoned.

Utilize or sell oldest stock first; it is most liable to attack.

Inspect all new stock to prevent the introduction of powder-posted material. If there is doubt as to whether or not new material is infested, place it in quarantine for several months.

Use only heartwood piling sticks in lumber piles.

To prevent attack, treat the more valuable material, between October and March, with boiled linseed oil. Varnish or paraffin the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture. Stock that has been submerged in water for 4 months or longer will not be liable to attack.

Material once attacked is usually damaged beyond repair. If the injury is not too far advanced, however, further damage can be stopped by trimming off the infested edges and saturating the wood with kerosene and creosote or with orthodichlorobenzene. Kiln drying at a temperature of 180° F., or steaming in a saturated atmosphere for 1½ hours at a temperature of 130° F., will destroy all stages of *Lyctus* powder-post beetles in wood 1 inch thick or less. Heavier dimension stock or stock of the same dimension subject to lower temperatures and humidities will require longer treatment.